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REPORT

ON SOME

CHEMICAL ANALYSES

OF THE

WATERS FROM THE SURFACE WELLS
AND PUMPS,

IN THE CITY OF LONDON.

BY

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*Presented to the Honourable the Commissioners of Sewers,
October, 1875.*

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1875.

*At a Meeting of the Commissioners of Sewers
of the City of London, held in the Guild-
hall of the said City, on Tuesday, the
19th October, 1875.*

JOHN STAPLES, ESQ., IN THE CHAIR.

The Medical Officer reported in respect of the several Pumps in this City.

RESOLVED—

That the same be referred to the SANITARY COMMITTEE for them to consider and report, that it be printed and circulated among the Members of this Commission, and that a copy be sent to the Deputies of each of the Wards referred to therein, and also to the Churchwardens of the Parishes in which the said Pumps are situated.

HENRY BLAKE,

Principal Clerk.

TO THE HONOURABLE THE COMMISSIONERS OF
SEWERS OF THE CITY OF LONDON.

GENTLEMEN,—Since I last reported to your Honourable Court upon the expediency, upon sanitary grounds, of closing for ever the few remaining pumps now in use in the City of London, public attention has been repeatedly and forcibly directed to the subject, and numerous applications have been made to me for information respecting the chemical qualities of the waters obtained from the surface wells in connection with such pumps.

Having already expressed my belief that the continued drinking of these waters, or even their employment for domestic purposes, is fraught with serious danger to the public health, and finding such conviction to run counter to popular prejudice in some of the districts immediately concerned, I have felt it my duty to lay before you the results of some analyses, made by myself and others, in order to demonstrate the grounds upon which I have based my appeal for

your interference. Accordingly, I submit a tabular statement of twelve determinations of water, taken from the pumps at Bartholomew Lane, Aldgate (at the junction of Leadenhall Street with Fenchurch Street), Crutched Friars, and Fann Street—these four being the only pumps to which the public have free access in the City of London. There are several others upon private ground, amongst them being two on the premises of the East and West India Dock Company's Warehouses in Jewry Street, one in Monkswell Street, one in Christ's Hospital, &c., &c.

These are all that remain of the 35 public pumps which were in use in the City in 1866, some of which were condemned by my predecessor and closed by the Local Authorities, whilst others have become dry by the construction of the deep sewers and subways since completed, which have utterly exhausted the sources of the supplies to the surface wells in connection with them. These surface wells vary from 25 to 30 feet in depth.

To the table below I have prefixed the results derived from a chemical examination of three samples of good waters, by way of comparison.

ANALYSES OF WATER FROM THE CITY PUMPS, &c.

	GRAINS PER GALLON.		PARTS PER MILLION.	
	Solids.	Chlorine.	Freo Ammonia.	Albuminoid Ammonia.
GOOD.				
New River Company - -	17·7	1·1	0·00	0·06
Thames - - - - -	18·5	1·2	0·01	0·06
Stand-pipe from Cab Stand	25	1·2	0·00	0·04
BAD.				
Aldgate Pump - - - -	103	10·5	0·72	0·12
Ditto ditto - - - -	108	9·4	0·48	0·08
Ditto ditto - - - -	111	10·3	0·56	0·10
Ditto ditto - - - -	not taken	10·1	0·58	0·11
Ditto ditto - - - -	88	11·1	0·01	0·76
Ditto ditto - - - -	not taken	10·5	0·25	0·26
Bartholomew Lane- - -	42	4·3	1·80	0·08
Ditto ditto - - - -	50	4·1	1·40	0·08
Ditto ditto - - - -	—	—	2·20	0·10
Crutched Friars - - -	73	4·3	0·04	0·10
Fann Street - - - - -	142	9·9	2·20	0·22
Ditto ditto - - - - -	not taken	not taken	2·10	0·16

The variations noticed in the different samples of the same water depend upon the time passed between the drawing of the water from the well and its analysis, upon the state of the rainfall, and upon other circumstances. Thus, if a sample be left for a month or two, the albuminoid ammonia increases

enormously, so that no two analyses can compare truthfully, unless taken at the same time and examined immediately ; very bad waters are known to change from day to day, a fact of much importance in experimenting with specimens in hot climates.

The samples included in the above table were operated upon in my Laboratory at various periods, and in different weathers, during the present year.

A glance at the analyses will show that the specimens taken from the four pumps mentioned are polluted with albuminoid ammonia (most probably of organic origin,) in poisonous quantities, and also with other products of urine and sewage.

I beg therefore again to assure you that the imperative demands of Public Health require that measures be taken for cutting off this subtle, but certain, source of disease.

Immediate notice should be given to the Ward and Parochial Authorities with whom the disposition of the pumps rest, and failing their prompt assent, a direct

application should be made to the Home Secretary ; since nothing short of peremptory action can avert the serious consequences which may arise at any moment.

Great ignorance exists in quarters where these pumps are in daily use, and much obstruction is met with from persons who argue, that because these waters are *bright, cool, and sparkling*, and because they have been unable to trace the mischief done to those who drink the same upon the faith of these appearances, that therefore they must, of necessity, be harmless.

Such people ignore the teachings of science, and despise the warnings of competent authorities, who have again and again informed them that the very qualities which have made the waters popular are produced by the presence of the products of decomposing nitrogenous matter of the most revolting kind, coming, as they do, in most cases from the graveyards in their immediate neighbourhood.

Under these circumstances I trust I may be deemed justified in travelling a little beyond the scope of an ordinary report, and enter briefly upon

a description of the scientific value of the different ingredients in the waters in common use, and draw the distinctions between their normal and abnormal constituents.

In analysing water for sanitary purposes it is essential to determine the following :—

- i.—The amount of total solids ;
- ii.—The amount of chlorine ;
- iii.—The amount of free ammonia ;
- iv.—The amount of albuminoid ammonia.

1st. The solids.—These consist of carbonate of lime, and chlorides (in the form of common salt), both of which are harmless unless very excessive ; of sulphate of lime ; sulphate and carbonate of magnesia (which are objectionable as making the water medicinal) ; of silica (about one-half of a grain to one grain per gallon in most waters) ; of traces of potash salts ; of metals (iron and alumina), and phosphates (more than a trace of which is incompatible with a water containing any carbonate of lime) ; also of nitrates (which are produced by the oxidation of nitrogenous organic matter, and may be combined with any base that happens to be present, *i.e.*, potash), &c.

The significance of these nitrates was formerly much exaggerated ; for whilst, on the one hand, they occur in surface wells, which, as a rule, are *impure*, they are also present in deep spring waters which are *pure*, and in which they have probably resulted from analogous chemical change occurring in remote geological antiquity.

Carbonic acid is sometimes produced by the oxidation of organic matter, and gives the sparkle to many bad waters ; but it may also be present in good waters independently of organic matter, and may be of mineral origin.

2nd. Chlorine.—The water from all surface wells must necessarily contain a considerable amount of chlorine in the form of chlorides of sodium, calcium, and magnesium (as a rule the two former only). The absence of chlorine denotes that the sample has been obtained from rain water, snow water, glacial water, lake water, distilled water, or from the water from volcanic rocks.

The presence of chlorine, although not necessarily indicating an absolutely impure water, nevertheless

serves as a warning of possible sewage contamination, since both urine and sewage contain it in large quantities, and in all such cases a further examination is called for.

3rd. Free ammonia.—Traces of ammonia occur in all waters, and it is only when these exceed certain well-ascertained quantities that they are suspected to proceed from the decomposition of urine.

4th. Albuminoid ammonia is the term introduced by Professor Wanklyn, the talented discoverer of the "Ammonia Process," who, as far back as 1867, described it "as the measure of the nitrogenous organic matter in waters by the quantities of ammonia yielded by the destruction of the organic matter."

A very limited appreciation of these four leading features in a water analysis will enable any candid observer to understand the following statement of the average results obtained from the twelve analyses tabulated above, and must, I think, carry conviction to the most sceptical. Thus, in the *solids*, the average of

the twelve analyses amounted to 89·6 as against 25·0 of the standard ; the *chlorine* amounted to 8·2 as against 1·2 ; the *free ammonia*, 1·03 as against 0·00 ; and the deadly *albuminoid ammonia*, 0·18 as against 0·04.

For sanitary purposes waters may be divided into three classes :—

I. Waters containing less than 0·05 parts per million of albuminoid ammonia ; these comprise—

- a.* Deep spring waters ;
- b.* The purest distilled water ;
- c.* Some very pure river waters ;
- d.* The best river waters as filtered and supplied by Water Companies.

II. Waters containing between 0·05 and 0·1 parts per million of albuminoid ammonia ; these comprise the ordinary water supply of the country (*i.e.*, the waters commonly delivered by Water Companies).

III. Waters containing over 0·1 parts per million of albuminoid ammonia. All water of this kind is doubtful, and much of it is dangerous.

The surface wells from which are obtained all the water drawn by the City pumps belong to the second and third classes, for they usually contain over 0·1 parts per million of albuminoid ammonia, and often an enormous quantity of free ammonia.

Occasionally these surface waters when they have been kept for a long time vegetate, in which case the free ammonia may be entirely absent, having become converted into vegetable albumen, or tissue; and when this takes place, the albuminoid ammonia is found very high.

I have the honour to be,

Your obedient Servant,

WM. SEDGWICK SAUNDERS.

13, QUEEN STREET, CHEAPSIDE,

19th October, 1875.

